IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of Kyusik Sin et al.		Ser. No:	09/828,635
Filing Date:	April 5, 2001	Examiner:	K. Bernatz
Atty. Docket No:	RR-1681	Technology Center:	1700

For: SPIN VALVE SENSORS HAVING SYNTHETIC ANTIFERROMAGNET FOR LONGITUDINAL BIAS

December 11, 2003

Mail Stop Appeal Brief
Commissioner for Patents
P.O. Box 1450
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BRIEF FOR APPELLANTS

This is an appeal of the Final Rejection of claims 1-20 dated May 27, 2003. A Notice of Appeal was filed September 18, 2003.

Real Party In Interest

Western Digital (Fremont), Inc. is the assignee of U.S. Application Serial No. 09/828,635 and is the real party in interest.

Related Appeals and Interferences

Appellants know of no other appeals or interferences that will directly affect or be directly affected by or have a bearing on the Board's decision in this pending appeal.

Status of Claims

The application was originally filed with 20 claims, which are the subject of this appeal. Appendix A lists the claims that are the subject of this appeal.

Status of Amendments

No amendments have been made.

Summary of Invention

The claims on appeal are directed to magnetoresistive (MR) sensors (100; 200) that offer improved mechanisms for reducing edge effects such as Barkhausen noise in a sensing layer. Such sensors include a pinned layer (104; 210) and a free layer (108; 208) with an exchange coupling layer (110; 206) adjoining the free layer, and a ferromagnetic layer (111, 112; 203; 205) having a fixed magnetic moment adjoining the exchange coupling layer. The exchange coupling layer and ferromagnetic layer form a synthetic antiferromagnetic structure with part of the free layer, providing bias that reduces magnetic instabilities at edges of the free layer.

Such synthetic antiferromagnetic structures can provide a stronger bias than conventional antiferromagnetic layers, as well as a more exactly defined track width than conventional hard magnetic bias layers. The synthetic antiferromagnetic structures can also provide protection for the free layer during processing, in contrast with the trimming of conventional antiferromagnetic layers that exposes if not removes part of the free layer.

Issues

(1) Whether claims 6, 7, and 17-20 are not enabled under 35 U.S.C. §112, first paragraph?

(2) Whether claims 17-20 are indefinite for failing to particularly point out and distinctly claim the subject matter which appellants regard as the invention under 35 U.S.C. §112, second paragraph?

(3) Whether claims 1-5, 10-14 and 16 are unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent Number 5,991,125 to Iwasaki et al. in view of U.S. Patent Number 6,496,338 to Hasegawa et al.?

(4) Whether claims 6, 7, and 9 are unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent Number 5,991,125 to Iwasaki et al. in view of U.S. Patent

Number 6,496,338 to Hasegawa et al. and U.S. Patent Number 5,995,338 to Watenabe et al.?

(5) Whether claims 8 and 15 are unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent Number 5,991,125 to Iwasaki et al. in view of U.S. Patent Number 6,496,338 to Hasegawa et al. and U.S. Patent Number 5,995,338 to Watanabe et al.?

(6) Whether claims 1-4, 10-12, 14 and 16 are unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent Number 6,122,151 to Saito et al. in view of U.S. Patent Number 5,910,868 to Kurosawa et al. and U.S. Patent Number 5,995,338 to Watanabe et al.?

(7) Whether claims 5 and 12 are unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent Number 6,122,151 to Saito et al. in view of U.S. Patent Number 5,910,868 to Kurosawa et al. and U.S. Patent Number 5,995,338 to Watanabe et al. and U.S. Patent Number 6,496,338 to Hasegawa et al.?

Grouping of Claims

Claims 6, 7, and 17-20 relate to Issue No. 1. The claims of this group do not stand or fall together.

Claims 17-20 relate to Issue No. 2. The claims of this group do not stand or fall together.

Claims 1-5, 10-14 and 16 relate to Issue No. 3. The claims of this group do not stand or fall together.

Claims 6, 7, and 9 relate to Issue No. 4. The claims of this group do not stand or fall together.

Claims 8 and 15 relate to Issue No. 5. The claims of this group do not stand or fall together.

Claims 1-4, 10-12, 14 and 16 relate to Issue No. 6. The claims of this group do not stand or fall together.

Claims 5 and 12 relate to Issue No. 7. The claims of this group do not stand or fall together.

Argument

I. Claims 6, 7, and 17-20 are adequately enabled under 35 U.S.C. §112, first paragraph.

The Final Rejection rejects claims 6, 7, and 17-20, for the reasons set forth in Paragraph No. 5 of the Office Action dated December 26, 2002. That paragraph stated:

> Claims 6, 7, 9 and 17 - 20 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. These claims contain reference to a third non-magnetic layer and/or a fourth ferromagnetic layer, yet the specification never describes a fourth ferromagnetic layer being present.

Appellants respectfully disagree. Referring to FIG. 3 for example, layer 104 may be a first ferromagnetic layer, layer 108 may be a second ferromagnetic layer, layer 111 may be a third ferromagnetic layer, and layer 112 may be a fourth ferromagnetic layer, for instance. As noted in paragraph 16 of the specification, layer 102 may be an antiferromagnetic (nonferromagnetic) layer that pins the magnetization of adjoining ferromagnetic layer 104, as would be understood by those of ordinary skill in the art. Layer 106 may be a second nonferromagnetic layer and layer 110 may be a third nonferromagnetic layer. The Office Action statements regarding 35 U.S.C. §112, first paragraph, are therefore incorrect.

The Final Rejection further states, with regard to claims 6, 7, and 17-20, that:

> Since applicants' claims must be read in light of the specification, the language "first" and "second" ferromagnetic layer is directed to those layers explicitly labeled as such by applicants.

Appellants respectfully disagree.

> That claims are interpreted in light of the specification does not mean that everything expressed in the specification must be read into all the claims. On the contrary, as was said in *Environmental Designs*, supra, 713 F.2d at 699, 218 USPQ at 871:
>
> "[T]he specification must be sufficiently explicit and complete to enable one skilled in the art to practice the invention, while a claim defines only that which the patentee regards as his invention. 35 U.S.C. §112. The claim, not the specification, measures the invention. (Case cited). The argument that claim 1 must include a limitation found in the specification is thus legally unsound."

Raytheon Co. v. Roper Corp., 220 USPQ 592, 597 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 835 (1984).

One of ordinary skill in the art would readily understand that labels such as "first" and "second" are general terms and do not require a particular order, in the specification or claims, unless so stated.

II. Claims 17-20 are not indefinite for failing to particularly point out and distinctly claim the subject matter which appellants regard as the invention under 35 U.S.C. §112, second paragraph.

The Final Rejection rejects claims 17-20, for the reasons set forth in Paragraph No. 7 of the Office Action dated December 26, 2002. That paragraph stated:

> Claims 2 and 17-20 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.
>
> Claims 17-20 are rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential structural cooperative relationships of elements, such omission amounting to a gap between the necessary structural connections. See MPEP § 2172.01. The omitted structural cooperative relationships are: the relative locations of the ferromagnetic layers, ferromagnetic "portions", and the non-magnetic layers, since the term "distal" in the claims is vague and indefinite. The examiner is unable to determine the scope of the present claims (see below for definition of the word "distal" from the Merriam-Webster dictionary).
>
> *Merriam-Webster definitions:*
> *Main Entry: dis-tal*
> *1: situated away from the point of attachment or origin or a central point especially of the body -- compare PROXIMAL*
>
> The Examiner recommends replacing the word "distal" with phrasing which more accurately defines the claimed invention.

No indication was given in the Office Action as to why claim 2 was rejected under 35 USC §112 ¶2, and so that rejection was withdrawn. Claims 18-20 also do not contain the term distal, and so appellants will focus on the rejection of claim 17.

Appellants respectfully disagree that the term distal, which is commonly used in patent claims, is vague. For example, a brief search of recent patents which include the

term "distal" in the claims, as well as the terms "magnet" and "sense" yields 487 patents. Are all of those patents invalid due to vagueness of the claims?

> The law is clear that "[i]f the claims, read in the light of the specification[s], reasonably apprise those skilled in the art both of the utilization and scope of the invention, and if the language is as precise as the subject matter permits, the courts can demand no more."

North American Vaccine, Inc. v. American Cyanamid Co., 28 USPQ 2d 1333, 1339 (Fed. Cir. 1993), *cert. denied*, 114 S. Ct. 1645 (1994).

Appellants respectfully assert that claims 17-20, when read in light of the specification, would not be indefinite to one of ordinary skill in the art. For example, a*ssuming arguendo* the Examiner's definition of distal as being "*situated away from the point of attachment,*" claim 17 can be interpreted with reference to FIG. 3 and paragraph 21 of the specification, for example as:

'first and second ferromagnetic layers (e.g., 111 and 112) that are disposed substantially in a plane,

a third ferromagnetic layer (e.g., 108) that is not disposed in said plane, said third ferromagnetic layer having a first portion (e.g., the portion of the free layer 108 located near edge 113) disposed adjacent to said first ferromagnetic layer, a second portion (e.g., the portion of the free layer 108 located near edge 114) disposed adjacent to said second ferromagnetic layer and a third portion (e.g., the portion of the free layer 108 the portion of the free layer that is not overlapped by the bias layers 111 and 112) disposed between said first and second portions and *situated away from* said first and second ferromagnetic layers,

a nonferromagnetic, electrically conductive layer (e.g., 106) adjoining said third ferromagnetic layer *away from* said first and second ferromagnetic layers...'

Because claim 17, when read in the light of the specification, reasonably apprises those skilled in the art both of the utilization and scope of the invention, claim 17 particularly points out and distinctly claims the subject matter which applicants regard as the invention under 35 U.S.C. §112, second paragraph. Although the above interpretation was offered to demonstrate the definiteness of claim 17, this is not the only interpretation of that claim or of claims 18, 19 and 20 that is sufficiently definite.

III. Claims 1-5, 10-14 and 16 are not unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent Number 5,991,125 to Iwasaki et al. in view of U.S. Patent Number 6,496,338 to Hasegawa et al.

The Final Rejection rejects claims 1-5, 10-14 and 16, for the reasons set forth in Paragraph No. 11 of the Office Action dated December 26, 2002. That paragraph stated:

> Claims 1-5, 10-14 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iwasaki et al. (U.S. Patent No. 5,991,125) in view of Hasegawa et al. (U.S. Patent No. 6,496,338 B2).
>
> Regarding claims 1- 3, 11 and 14I Iwasaki et al. disclose a sensor comprising: first *(Figure* 21, *element* 16), second *(element* 11) and third ferromagnetic layers *(element* 13) that are interleaved with first *(element* 5) and second *(element* 12) electrically conductive nonmagnetic layers (col. 10, lines 27- 44 and lines 55- 60), said first nonmagnetic layer adjoining said first and second ferromagnetic layers (*elements* 14/5/11), said second nonmagnetic layer adjoining said second and third ferromagnetic layers *(elements 11/12/13),* said first and third ferromagnetic layers having magnetic moments with directions that are fixed in response to an applied magnetic field *(i.e. are "pinned" magnetic layers - see Figure* 21 *and col.* 15, *line* 61 *bridging col.* 16, *line* 4), said second ferromagnetic layer having a free portion, said free portion having a magnetic moment with a direction that rotates in response to said applied magnetic field *(i.e. is* a *"free" magnetic layer- see Figure* 21 *col.* 10, *lines* 27- 44).
>
> Iwasaki et al. fail to disclose the third ferromagnetic layer overlapping only a portion of the second magnetic layer.
>
> However, Hasegawa et al. teach forming a sensor wherein the bias element *(Figure* 1, *element* 35) only covers an exterior of the free magnetic layer (*element* 34) in order to suppress Barkhausen noise and to pin part of the free magnetic layer by exchange coupling (col. 1, line 56 bridging col. 2, line 47 and Figures 2 and 10).
>
> It would therefore have been obvious to one of ordinary skill in the art at the time of the applicant's invention to modify the device of Iwasaki et al. to form the layers above the free magnetic layer *(Iwasaki et al. - element* 11) such that they only over the outer portion of the free magnetic layer as taught by Hasegawa et al. in order to pin the exterior part of the free magnetic layer via exchange coupling, thereby suppressing Barkhausen noise generation.

As noted in appellants' previous response, in addition to the limitations of claim 1 that the Office Action admits are not disclosed Iwasaki et al., Iwasaki et al. does not disclose a fixed portion of a second ferromagnetic layer.

The Final Rejection in paragraph 16 agrees that "Iwasaki et al. does not disclose a fixed portion of a second ferromagnetic layer." The Final Rejection, however, states:

> This limitation was addressed on page 9 of the Office Action mailed December 26, 2002 (Paper No. 3). Specifically, the Examiner deemed that such a limitation would necessarily result from the combined teachings of Iwasaki et al. in view of Hasegawa et al. since the claimed and prior art structures would be substantially identical.

Page 9 of the Office Action, in relevant part, states:

> Therefore, in addition to the above disclosed limitations, the presently claimed properties of:
>
> The second ferromagnetic layer having a fixed portion, said fixed portion having a magnetic moment with a direction that does not rotate in response to said applied magnetic field (*i.e., the definition of pinning and equivalent to claim 14- "a magnetically stabilized portion"*) and wherein said third ferromagnetic layer overlaps said fixed portion and does not overlap aid free portion
>
> Would have been inherently present because the claimed and prior art products are substantially identical in structure, and there is no evidence currently of record showing that the disclosed prior art products do not necessarily possess the characteristics of the claimed product (see also Figure 2 of Hasegawa et al., teaching a magnetic layer having three separate magnetization regions).

Appellants respectfully but strongly disagree that "such a limitation would necessarily result from the combined teachings of Iwasaki et al. in view of Hasegawa et al. since the claimed and prior art structures would be substantially identical." There is no indication that layer 11 of Iwasaki et al., which the Office Action labels a "second ferromagnetic layer," has a "fixed portion." Further, should the device of Iwasaki et al. be modified as proposed in the Office Action "to form the layers above the free magnetic layer *(Iwasaki et al. - element* 11) such that they only over (*sic*) the outer portion of the free magnetic layer as taught by Hasegawa et al," it is unlikely that the free magnetic layer would be pinned.

For example, Iwasaki et al. state, in column 10, lines 55-57: "In the present invention, the material of the intermediate layer 12 is for example Au, Ag, or an alloy that mainly contains Cu Au or Ag as well as Cu." Iwasaki et al. describe, in column 13, lines 55-56: "an intermediate layer (Cu) 12 with a thickness of 3 nm." Appellants respectfully assert that these materials are not known to those of ordinary skill in the art

to provide antiferromagnetic coupling, especially given the 3 nm thickness of layer 12. Therefore, not only would such a limitation not necessarily result, such a limitation would be unlikely to result, without using the present disclosure as a template for that modification.

Appellants also respectfully but strongly disagree with the argument that the limitation at issue is "inherent" in the cited references because there is no evidence of record that it is not. Note that the Final rejection also states that "attorney arguments are not considered evidence." Thus it appears that the Examiner would like to be able to call an invention "obvious" and not allow an attorney to argue that it is not. This is not the criterion for obviousness.

Instead, note that both cases cited by the Examiner [In re Best, 195 USPQ 430 (CCPA 1977) and In re Spada, 15 USPQ 2d 1655 (Fed Cir. 1990)] involve anticipation by inherency or prima facie obviousness, rather than obviousness by inherency as applied to the claims on appeal. For example, in each case a rejection was sustained over a single prior art reference. In re Best, on page 432, also contradicts the Examiner's statement of the law, by noting that "indirect comparisons, based on established scientific principles, can validly be applied to distinguish a claimed chemical process or product from that disclosed in the prior art. *In re Blondel*, 499 F.2d 1311, 182 USPQ 294 (CCPA 1974)." Moreover, "That which may be inherent is not necessarily known. Obviousness cannot be predicated on what is unknown." In re Spormann, 150 USPQ 449, 452 (C.C.P.A. 1966).

As noted above, the modification proposed by the Office Action would not result in a "substantially identical" structure as that defined in claim 1. Moreover, FIG. 2 of Hasegawa et al., which is cited by the Office Action, does not appear to be described in the text of that patent, and does not disclose the limitation at issue.

Furthermore, should the device of Iwasaki et al. be modified as proposed by the Office Action, the resulting device would not work as well as it would without modification. That is, should the device of Iwasaki et al. be modified to form the layers (12, 13, 14 and 15) of Iwasaki et al. above the free layer 11 so that they only over (*sic*) the outer portion of the free magnetic layer (11), the electrically conductive intermediate layer (12) would be removed, destroying the spin valve effect in that region.

In response to this reasoning, the Final Rejection asserts:

> The Examiner notes that the "electrically conductive intermediate layer (12)" could be removed or not removed, as would be recognized by one of ordinary skill in the art. If the electrically conductive layer (12) was not removed, it would serve as a protection layer over the exposed track width portion of the free magnetic layer (11). This would result in one less etching step, thereby decreasing production cost and time. Alternatively, the conductive layer could be deposited only on the edge portions, reducing the amount of electrically conductive material used, thereby decreasing cost. Furthermore, Iwasaki et al. teach that the intermediate layer (12) primarily functions to provide antiferromagnetic coupling between the adjacent magnetic layers, which would still occur except only at the edge portions of the layers (*col. 17, lines 18 – 61*). Hasegawa et al. teach that utilizing a structure providing biasing on each end of the free magnetic layer pins the magnetization at both ends of the free magnetic layer, reducing the occurrence of noise (*col. 9, line 56 bridging col. 10, line 10*). Therefore, the Examiner deems that there is sufficient teaching in the prior art that such a combination would not destroy the disclosed Iwasaki et al. invention and applicants have presented no evidence that such a modification would destroy the claimed invention (attorney arguments are not considered evidence).

Note initially that the Office Action proposes modification of Iwasaki et al. "to form the layers of Iwasaki et al. above the free layer (*Iwasaki et al. – element 11*) so that they only over (*sic*) the outer portion of the free magnetic layer as taught by Hasegawa et al," whereas the Final Rejection proposes either removing or not removing layer 12, which is over layer 11. One of ordinary skill in the art would not have attempted either of the Office Action proposals, however, because neither would work as well as the unmodified device. Should the conductive layer 12 be removed along with the layers above it, magnetoresistive current would not flow through layer 12, thereby lowering the magnetoresistive effect. Should the conductive layer 12 remain while the layers above it were removed, current would flow through that layer regardless of an applied magnetic field, also thereby lowering the magnetoresistive effect.

The Final Rejection assertion that "the conductive layer (12) could be deposited only on the edge portions" would not have been accepted as reasonable by one of ordinary skill in the art. First, one of such skill would realize that to provide this accurate deposition would require a mask that would cover a middle portion of the free layer 11 and thereby contaminate that delicate layer 11, reducing if not destroying the magnetoresistive effect of that layer. Moreover, this would not result in "reducing the

amount of electrically conductive material used, thereby decreasing cost," as alleged in the Final Rejection, because the conductive layer would be deposited on the mask to be removed later. Thus another large disincentive to the modification proposed by the Final Rejection would exist.

The Final Rejection assertion that leaving the conductive layer "would result in one less etching step, thereby decreasing production cost and time" would also not have been believed by one of ordinary skill in the art. Etching of layer 12 would occur in the same etching step as that which removed the layers above layer 12, and the extra time involved in etching layer 12 would likely be measured in seconds and not significant. Thus no incentive for adopting the Final Rejection proposal would have been evident to one of ordinary skill in the art, and large disincentives would have been evident.

Independent claim 11 was not specifically addressed in the Final Rejection or the Office Action, and is also nonobvious over the cited references. Claim 11 recites:

> A sensor comprising:
> a ferromagnetic pinned layer and a ferromagnetic free layer that are separated by an electrically conductive spacer layer,
> a pinning structure adjoining said pinned layer and adapted to fix a magnetic moment of said pinned layer in a first direction,
> a bias structure adjoining said free layer and adapted to stabilize magnetic domains of said free layer in a second direction, said bias structure including a ferromagnetic bias layer exchange coupled to a portion of said free layer by a nonferromagnetic layer.

In contrast to claim 11, Iwasaki et al. do not disclose "a bias structure adjoining said free layer and adapted to stabilize magnetic domains of said free layer in a second direction, said bias structure including a ferromagnetic bias layer exchange coupled to a portion of said free layer by a nonferromagnetic layer." Moreover, should the device of Iwasaki et al be modified as proposed in the Office Action "to form the layers above the free magnetic layer *(Iwasaki et al. - element* 11) such that they only over (*sic*) the outer portion of the free magnetic layer as taught by Hasegawa et al.," the limitation of "a ferromagnetic bias layer exchange coupled to a portion of said free layer by a nonferromagnetic layer" would still be absent. Lacking this exchange coupling, the magnetic domains of the free layer would not be stabilized, also in contrast to claim 11.

For at least these reasons, claim 11 and the claims dependent from claim 11 are not obvious over Iwasaki et al. as proposedly modified by Hasegawa et al.

Independent claim 17 was also not specifically addressed in the Final Rejection or the Office Action regarding obviousness, and is also nonobvious over the cited references.

Claim 11 recites:

> 17. A sensor comprising:
>
> first and second ferromagnetic layers that are disposed substantially in a plane,
>
> a third ferromagnetic layer that is not disposed in said plane, said third ferromagnetic layer having a first portion disposed adjacent to said first ferromagnetic layer, a second portion disposed adjacent to said second ferromagnetic layer and a third portion disposed between said first and second portions and distal to said first and second ferromagnetic layers,
>
> a nonferromagnetic, electrically conductive layer adjoining said third ferromagnetic layer distal to said first and second ferromagnetic layers, and
>
> a fourth ferromagnetic layer adjoining said conductive layer,
>
> wherein said fourth ferromagnetic layer has a magnetic moment that is fixed in the presence of an applied magnetic field, said first and second portions of said third ferromagnetic layer have magnetic moments that are fixed in the presence of said applied magnetic field and said third portion of said third ferromagnetic layer has a magnetic moment that varies in response to said applied magnetic field.

In contrast to claim 17, Iwasaki et al. do not disclose "first and second portions of said third ferromagnetic layer have magnetic moments that are fixed in the presence of said applied magnetic field and said third portion of said third ferromagnetic layer has a magnetic moment that varies in response to said applied magnetic field." Moreover, should the device of Iwasaki et al be modified as proposed in the Office Action "to form the layers above the free magnetic layer *(Iwasaki et al. - element* 11) such that they only over (*sic*) the outer portion of the free magnetic layer as taught by Hasegawa et al.," the limitation of "first and second portions of said third ferromagnetic layer have magnetic moments that are fixed in the presence of said applied magnetic field and said third portion of said third ferromagnetic layer has a magnetic moment that varies in response to said applied magnetic field" would still be absent. For at least these reasons, claim 17

and the claims dependent from claim 17 are not obvious over Iwasaki et al. as proposedly modified by Hasegawa et al.

IV. Claims 6, 7, and 9 are not unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent Number 5,991,125 to Iwasaki et al. in view of U.S. Patent Number 6,496,338 to Hasegawa et al. and U.S. Patent Number 6,396,734 to Ishikawa et al.

The Final Rejection rejects claims 6, 7, and 9 for the reasons set forth in Paragraph No. 12 of the Office Action dated December 26, 2002. That paragraph stated:

> Claims 6, 7, and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iwasaki et al. in view of Hasegawa et al. as applied above, and further in view of Ishikawa et al. (U.S. Patent No. 6,396,734 B2).
>
> Regarding claims 6, 7 and 9 Iwasaki et al. in view of Hasegawa et al. are relied upon as described above.
>
> Neither Iwasaki et al. nor Hasegawa et al. disclose a fourth ferromagnetic layer and a third nonmagnetic layer meeting applicants' claimed limitations. However, Ishikawa et al. teach that it is old in the art to substitute a single pinned layer with a synthetic pinned layer comprising an additional ferromagnetic layer and a non-magnetic layer inorder to reduce the static magnetic field, thereby remedying the peak asymmetry of the read-back waveform of the head (col. 3, lines 9-24). Replacement of the pinned magnetic layer (Iwasaki et al., element 13) with a ferromagnetic/non-magnetic/ferromagnetic synthetic pinned layer would meet applicants' claimed limitations.
>
> It would therefore have been obvious to one of ordinary skill in the art at the time of the applicants' invention to modify the device of Iwasaki et al. in view of Hasegawa et al. to utilize a synthetic pinned magnetic layer, thereby meeting applicants' claimed limitations, as taught by Ishikawa et al. inorder to reduce the static magnetic field, thereby remedying the peak asymmetry of the read-back waveform of the head.

This rejection is predicated on the previous rejection and suffers from the same defects that were mentioned above.

In addition, note that should the device of Iwasaki et al. be modified to form the layers (12, 13, 14 and 15) of Iwasaki et al. above the free layer 11 so that they only over (*sic*) the outer portion of the free magnetic layer (11), the electrically conductive intermediate layer (12) would not be functional, as discussed above, and so no need would exist for a pinning layer (13). Therefore, the motivation proposed by this Office

Action proposal to further modify the modified device of Iwasaki et al. would not exist. Stated differently, the peak asymmetry of the read-back waveform of the head would not be affected by this latest modification to layer 13, since the prior proposed modification would have destroyed the ability of the adjoining layer 12 to be used for reading.

V. Claims 8 and 15 are not unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent Number 5,991,125 to Iwasaki et al. in view of U.S. Patent Number 6,496,338 to Hasegawa et al. and U.S. Patent Number 5,995,338 to Watenabe et al.

The Final Rejection rejects claims 8 and 15 for the reasons set forth in Paragraph No. 13 of the Office Action dated December 26, 2002. That paragraph stated:

> Claims 8 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iwasaki et al. in view of Hasegawa et al. as applied above, and further in view of Watenabe et al. (U.S. Patent No. 5,995,338 B2).
>
> Regarding claims 8 and 15, Iwasaki et al. in view of Hasagawa et al. are relied upon as described above.
>
> Neither Iwasaki et al. nor Hasagawa et al. disclose a non-magnetic layer meeting applicants' claimed limitations.
>
> However, the claimed limitations are known equivalents to Cu (used by Iwasaki et al.), as taught by Watenabe et al. (col. 8, lines 33-37).
>
> Substitution of equivalents requires no express motivation as long as the prior art recognizes the equivalency. In the instant case, Cu, Ru, Rh and Ir are equivalents in the field of nonmagnetic conductive elements for nonmagnetic conductive layers in sensors. *In re Fount* 213 USOQ 532 (CCPA 1982); *In re Siebrentritt* 152 USPQ 618 (CCPA 1967); *Graver Tank & Mfg. Co. Inc. v. Linde Air Products Co.* 85 USPQ 328 (USSC 1950).

This rejection is also predicated on the earlier rejection proposing a modification of Iwasaki et al. in view of Hasagawa et al. and suffers from the same defects that were mentioned above.

In addition, note that according to the passage of Watenabe et al. that was cited in the Office Action (column 8, lines 33-37), "it is desirable to use a material that does not have a spontaneous magnetization at room temperatures, and has a good electron transmissivity." This definition would seem to fit all non-magnetic, electrically conductive materials. One of ordinary skill in the art would not believe that all non-

magnetic, electrically conductive materials are equivalent, however, despite the quotation of Watenabe et al.

Assuming arguendo that the device of Iwasaki et al. was modified as proposed in the Office Action, and then further modified as proposed in the Office Action to substitute ruthenium, iridium or rhodium for the conductive, non-magnetic film of Iwasaki et al., the repeatedly modified device would not meet the claimed limitations. For example, the second ferromagnetic layer would not have a fixed part, as it would not be pinned by the adjacent layer of ruthenium, iridium or rhodium.

VI. Claims 1-4, 10-12, 14 and 16 are not unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent Number 6,122,151 to Saito et al. in view of U.S. Patent Number 5,910,868 to Kurosawa et al. and U.S. Patent Number 5,995,338 to Watanabe et al.

The Final Rejection rejects claims 1-4, 10-12, 14 and 16 for the reasons set forth in Paragraph No. 14 of the Office Action dated December 26, 2002. That paragraph stated:

> Claims 1-4, and 10-12, 14 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Saito et al. (U.S. Patent No. 6,122,151) in view of Kurosawa et al. (U.S. Patent No. 5,910,868) as applied above, and further in view of Watenabe et al. ('338).
>
> Regarding claims 1-3, 11 and 14, Saito et al. disclose a sensor comprising first (Figure 3, element 2), second (element 4) and third ferromagnetic layers (element 10) that are interleaved with first (element 3) electrically conductive non-magnetic layer (col. 6, lines 15-18), said first nonmagnetic layer adjoining said first and second ferromagnetic layers (elements 2/3/4), wherein said third ferromagnetic layer overlaps only a portion of said second ferromagnetic layer.
>
> Regarding the limitations in the magnetization of the second ferromagnetic layer, the disclosed prior art as taught by Saito et al. is substantially identical in structure to the claimed product (i.e., a spin valve sensor comprising a lower antiferromagnetic layer (element 1), a pinned magnetic layer, a free magnetic layer, a second pinned magnetic layer and a biasing layer (element 5), wherein the second pinned magnetic layer is broken into sections only extending over part of the free magnetic layer – See applicants' Figure 3).

Initially note that in addition to the elements that the Office Action note are absent from the cited references, Saito et al. do not disclose a "second nonferromagnetic layer adjoining said second and third ferromagnetic layers" as recited in claim 1. For this reason Saito is not "substantially identical" or "equivalent" to claim 1, in contrast to the Office Action assertions. Therefore, all of the limitations alleged by the Office Action to be inherent in Saito et al. would not have been inherent, even if *assuming arguendo*, one were to accept the Examiner's statement of the law of obviousness by inherency. Alternatively, the Office Action is alleging inherency in an obviousness rejection, whereas the cases cited by the Examiner involved anticipation by inherency or prima facie obviousness, and so the Office Action's legal basis is flawed.

The Office Action continues by alleging:

> While Saito et al. disclose a bias layer comprising a CoCr hard magnetic alloy, the examiner notes that antiferromagnetic bias layers are known equivalents and perform the same function (i.e. there is sound basis for the inherency of the properties above even though applicants use an antiferromagnetic layer and Saito et al. use a CoCr hard magnetic bias layer).
>
> See Watenabe et al. ('338) for support that these materials are known equivalents for bias layers (col. 9, lines 54-55 and col. 18, lines 20-27: "*the same effect can be obtained when... an antiferromagnetic thin film having a body-centered cubic lattice structure is used*").
>
> Neither Saito et al. nor Watenabe et al. disclose a second nonmagnetic layer meeting applicants' claimed limitations.
>
> However, Kurosawa et al. teach forming a sensor where a nonmagnetic layer is inserted directly below a ferromagnetic/ antiferromagnetic layer structure (*i.e. Saito et al., elements 5 and 10*) inorder to improve the Hua of the antiferromagnetic layer (col. 3, lines 3-13 and lines 63-65).
>
> It would therefore have been obvious to one of ordinary skill in the art at the time of the applicant's invention to modify the device of Saito et al. to form a non-magnetic layer between the second and third magnetic layers inorder to improve the Hua of the antiferromagnetic layer deposited on the third magnetic layer.

Appellants respectfully disagree with the Office Action characterization of Kurosawa et al. as teaching forming a sensor where a nonmagnetic layer is inserted directly below a ferromagnetic/ antiferromagnetic layer structure. No such insertion is taught by Kurosawa et al. In fact, Kurosawa et al. teach that a nonmagnetic layer (Ta) is present in a prior art sensor (column 1, line 65 – column 2, line 6). Note that the sensor

of Kurosawa et al. is not a spin valve sensor and does not function like that of the present application. For example, a Ta layer would have a much higher resistance than a nonmagnetic, electrically conductive spacer used in a spin valve sensor, and so would not have been employed in the sensor of Saito et al., because a resistive Ta layer would lower the sensitivity of the sensor. Instead, Kurosawa et al. teach, in column 2, lines 6-7, a soft adjacent layer (SAL) 8, that "provides the MR layer 3 with a transverse bias filed (sic) to maintain the reading operation linear." One of ordinary skill in the art would have recognized that this is a very different form of operation than that employed by Saito et al., and would not have blindly modified Saito et al. with this Ta layer "inorder to improve the Hua of the antiferromagnetic layer," as asserted in the Office Action.

Independent claim 11 was not specifically addressed in the Final Rejection or the Office Action, and is also nonobvious over the cited references. Claim 11 recites:

> A sensor comprising:
> a ferromagnetic pinned layer and a ferromagnetic free layer that are separated by an electrically conductive spacer layer,
> a pinning structure adjoining said pinned layer and adapted to fix a magnetic moment of said pinned layer in a first direction,
> a bias structure adjoining said free layer and adapted to stabilize magnetic domains of said free layer in a second direction, said bias structure including a ferromagnetic bias layer exchange coupled to a portion of said free layer by a nonferromagnetic layer.

In contrast to claim 11, Saito et al. do not disclose "a bias structure adjoining said free layer and adapted to stabilize magnetic domains of said free layer in a second direction, said bias structure including a ferromagnetic bias layer exchange coupled to a portion of said free layer by a nonferromagnetic layer." Moreover, should the device of Saito et al be modified as proposed in the Office Action to form a non-magnetic layer between the second and third magnetic layers inorder to improve the Hua of the antiferromagnetic layer deposited on the third magnetic layer as taught by Kurosawa et al., the limitation of "a ferromagnetic bias layer exchange coupled to a portion of said free layer by a nonferromagnetic layer" would still be absent. Moreover, adding a nonmagnetic layer of tantalum (Ta) as suggested by Kurosawa et al. would decrease the magnetoresistance of the device, and would not have been attempted by one of ordinary

skill. For at least these reasons, claim 11 and the claims dependent from claim 11 are not obvious over Iwasaki et al. as proposedly modified by Hasegawa et al.

VII. Claims 5 and 13 are not unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent Number 6,122,151 to Saito et al. in view of U.S. Patent Number 5,910,868 to Kurosawa et al. and U.S. Patent Number 5,995,338 to Watanabe et al. and U.S. Patent Number 6,496,338 to Hasegawa et al.

The Final Rejection states:

> Claims 5 and 13 are rejected under 35 U.S.C. §103(a) as being unpatentable over Saito et al. ('151) in view of Kurosawa et al. ('868) and Watanabe et al. ('338) as applied above, and further in view of Hasegawa et al. for the reasons set forth in Paragraph No. 15 of the Office Action dated December 26, 2002 (Paper No. 3).
>
> The Examiner notes that the original rejection had a typographical error referred to "claims 5 and 12", yet it is clear that claims 5 and 13 were intended since both claims 5 and 13 cover substantially identical subject matter (and claim 12 had already been rejected in paragraph 14).

Appellants respectfully object to this new ground of rejection of claim 13 that was provided in the second and Final Office Action. MPEP 706.07(a) states:

> Under present practice, second or any subsequent actions on the merits shall be final, except where the examiner introduces a new ground of rejection that is neither necessitated by applicant 's amendment of the claims nor based on information submitted in an information disclosure statement filed during the period set forth in 37 CFR 1.97(c) with the fee set forth in 37 CFR 1.17(p).

Appellants respectfully disagree with the Examiner that the rejection of claim 13 in the first Office Action was clear. The first Office Action was 17 pages in length and replete with errors and misstatements of the law, including rejections based on "open language," incorrect recital of necessary abstract length, rejections of claims for which no reason was presented, arguments that obviousness rejections of the Examiner could not be rebutted by attorney arguments but only by evidence, mischaracterization of court holdings based on anticipation by inherency as instead holdings of obviousness by inherency, vague rejections that recite "they only over the outer portion" so that it is not clear whether "they only are over the outer portion" or "they only cover the outer

portion" is intended, arguments that "first and second" as recited in the claims must necessarily be given the meaning of "first and second" described in one embodiment of the specification, etc.

Through this maze of mistakes, the Final Rejection asserts that appellants were supposed to infer that the Office Action intended to reject a different claim than was rejected, because the claim that was actually rejected was also rejected elsewhere, and because the claim that was supposed to be rejected covers "substantially identical subject matter" as another rejected claim. First, note that many of the claims were rejected on more than one basis and in more than one paragraph. Second, "substantially identical" has been used so broadly in the Office Action that all the claims could be considered "substantially identical." For example, the Office Action in paragraph 14 asserted that "the claimed and prior art products are substantially identical in structure" despite the fact that the prior art structures lacked material elements of the claims, as discussed above in argument VI. What then does "substantially identical" mean, except to provide a blanket license to invoke "inherency" in an obviousness rejection? What is clear is the rule, quoted above, that a second or any subsequent actions on the merits shall not be final where the examiner introduces a new ground of rejection that is neither necessitated by applicant's amendment of the claims nor based on information submitted in an information disclosure statement filed during the period set forth in 37 CFR 1.97(c) with the fee set forth in 37 CFR 1.17(p).

Paragraph 15 of the Office Action admits that none of Saito et al., Kurosawa et al. nor Watenabe et al. as proposedly modified by the Office Action teach antiferromagnetic layers meeting applicants claimed blocking temperature limitations. Regarding the rejection of claims 5 and 13 provided in the Final Rejection, this rejection is predicated on the previous rejection discussed above in argument VI and suffers from the same defects that were mentioned above.

In addition, appellants respectfully disagree with the Office Action assertion:

> However, Hasegawa et al. teach a spin valve sensor comprising an upper and lower antiferromagnetic layer wherein the two layers are taught to be unique from each other in composition, and hence, blocking temperature, inorder to produce a sensor having excellent corrosion resistance, linear response and requiring no special heat treating equipment.

It would therefore have been obvious to one of ordinary skill in the art at the time of the applicant's invention to modify the device of SKW et al. to use antiferromagnetic layers meeting applicants' claimed limitations as taught by Hasegawa et al. inorder to produce a sensor having excellent corrosion resistance, linear response and requiring no special heat treating equipment.

Initially note that different antiferromagnetic layer compositions do not necessarily have different blocking temperatures. This alone negates the obviousness rejection. Moreover, should the antiferromagnetic layers of Hasegawa et al. be used in place of those of Saito et al. as proposedly modified by Kurosawa et al. and Watenabe et al. the resulting structure would not have a "second nonferromagnetic layer adjoining said second and third ferromagnetic layers" as recited in claim 1, from which claim 5 depends. Further, should the antiferromagnetic layers of Hasegawa et al. be used in place of those of Saito et al. as proposedly modified by Kurosawa et al. and Watenabe et al. the resulting structure would not have "a ferromagnetic bias layer exchange coupled to a portion of said free layer by a nonferromagnetic layer" as recited in claim 11, from which claim 13 depends.

VIII. Claims 6, 7 and 9 are not unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent Number 6,122,151 to Saito et al. in view of U.S. Patent Number 5,910,868 to Kurosawa et al. and U.S. Patent Number 5,995,338 to Watanabe et al. and U.S. Patent Number 6,396,734 to Ishikawa et al.

The Final Rejection states:

> Claims 6, 7 and 9 are rejected under 35 U.S.C. §103(a) as being unpatentable over Saito et al. ('151) in view of Kurosawa et al. ('868) and Watanabe et al. ('338) as applied above, and further in view of Ishikawa et al. ('734) for the reasons set forth in Paragraph No. 16 of the Office Action dated December 26, 2002 (Paper No. 3).

That paragraph stated, in part:

> None of SKW et al. disclose a fourth ferromagnetic layer and a third nonferromagnetic layer meeting applicants' claimed limitations.
>
> However, Ishikawa et al. teach that it is old in the art to substitute a single pinned layer with a synthetic pinned ferromagnetic layer comprising an additional ferromagnetic layer and a non-magnetic layer inorder to reduce the static magnetic field, thereby remedying the peak

asymmetry of the read-back waveform of the head (col. 3, lines 9-24). Replacement of the pinned magnetic layer (*Saito et al., element 10*) with a ferromagnetic/non-magnetic/ferromagnetic synthetic pinned layer would meet applicants' claimed limitations.

It would therefore have been obvious to one of ordinary skill in the art at the time of the applicant's invention to modify the device of SKW et al. to utilize a synthetic pinned magnetic layer, thereby meeting applicants' claimed limitations, as taught by Ishikawa et al. inorder to reduce the static magnetic field, thereby remedying the peak asymmetry of the read-back waveform of the head.

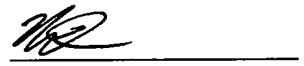
Initially, appellants respectfully disagree with the Office Action statement that "Ishikawa et al. teach that it is old in the art to substitute a single pinned layer with a synthetic pinned ferromagnetic layer comprising an additional ferromagnetic layer and a non-magnetic layer." Appellants further respectfully disagree that the modification proposed by the Office Action would be attempted by one of ordinary skill in the art. As noted above, the Office Action's proposed SKW et al. combination requires a Ta spacer layer that is electrically resistant, thus decreasing the sensitivity of the sensor. An additional resistant spacer layer would not have been provided by one of ordinary skill in the art, and providing a conductive spacer layer would increase rather than reduce the peak asymmetry. Assuming arguendo that an additional ferromagnetic layer and a non-magnetic layer would have been provided as proposed by the Office Action, the resulting device would still be different than that recited in claims 6, 7 or 9.

Conclusion

Appellants respectfully assert that all the pending claims are allowable and therefore request reversal of the Examiner's rejections. The pending claims are adequately enabled under 35 U.S.C. §112, first paragraph, and are not indefinite under 35 U.S.C. §112, second paragraph. The pending claims are also not obvious over the prior art cited, since the prior art cited does not teach or suggest modification to achieve the invention defined by the claims on appeal. *Assuming arguendo* that one of ordinary skill in the art would have modified the references as proposed by the Examiner, the pending claims would be different from and nonobvious over the modified references.

This brief is being submitted in triplicate along with a Petition for a One-Month Extension of Time and a check in the amount of $440.00 as payment of the fee required for the Appeal Brief ($330.00) and the Petition ($110.00).

Respectfully submitted,



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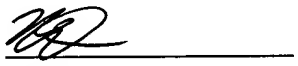

Mark Lauer

Appendix A

1. A sensor comprising:

first, second and third ferromagnetic layers that are interleaved with first and second nonferromagnetic layers, said first nonferromagnetic layer adjoining said first and second ferromagnetic layers, said second nonferromagnetic layer adjoining said second and third ferromagnetic layers, said first and third ferromagnetic layers having magnetic moments with directions that are fixed in response to an applied magnetic field, said second ferromagnetic layer having a free portion and a fixed portion, said free portion having a magnetic moment with a direction that rotates in response to said applied magnetic field and said fixed portion having a magnetic moment with a direction that does not rotate in response to said applied magnetic field.

2. The sensor of claim 1, wherein said third ferromagnetic layer overlaps said fixed portion and does not overlap said free portion.

3. The sensor of claim 1, wherein at least one of said first and second nonferromagnetic layers is electrically conductive.

4. The sensor of claim 1, further comprising an antiferromagnetic layer adjoining at least one of said first and third ferromagnetic layers.

5. The sensor of claim 1, further comprising first and second antiferromagnetic layers having different blocking temperatures, said first antiferromagnetic layer adjoining said first ferromagnetic layer and said second antiferromagnetic layer adjoining said third ferromagnetic layer.

6. The sensor of claim 1, further comprising a fourth ferromagnetic layer and a third nonferromagnetic layer, wherein said third nonferromagnetic layer adjoins said third and fourth ferromagnetic layers.

7. The sensor of claim 6, further comprising an antiferromagnetic layer adjoining at least one of said first and fourth ferromagnetic layers.

8. The sensor of claim 1, wherein at least one of said first and second nonferromagnetic layers includes ruthenium, iridium or rhodium.

9. The sensor of claim 1, further comprising a fourth ferromagnetic layer adjoining said second nonferromagnetic layer and separated from said third ferromagnetic layer.

10. The sensor of claim 1, wherein said directions of said magnetic moments of said first and third ferromagnetic layers are substantially perpendicular.

11. A sensor comprising:

a ferromagnetic pinned layer and a ferromagnetic free layer that are separated by an electrically conductive spacer layer,

a pinning structure adjoining said pinned layer and adapted to fix a magnetic moment of said pinned layer in a first direction,

a bias structure adjoining said free layer and adapted to stabilize magnetic domains of said free layer in a second direction, said bias structure including a ferromagnetic bias layer exchange coupled to a portion of said free layer by a nonferromagnetic layer.

12. The sensor of claim 11, wherein at least one of said pinning structure and said bias structure includes an antiferromagnetic layer.

13. The sensor of claim 11, wherein said pinning structure includes a first antiferromagnetic layer and said bias structure includes a second antiferromagnetic layer, said first antiferromagnetic layer having a different blocking temperature than said second antiferromagnetic layer.

14. The sensor of claim 11, wherein said free layer has a magnetically stabilized portion adjacent to said bias layer.

15. The sensor of claim 11, wherein said nonferromagnetic layer includes ruthenium, iridium or rhodium.

16. The sensor of claim 11, wherein said directions of said magnetic moments of said first and third ferromagnetic layers are substantially perpendicular.

17. A sensor comprising:

first and second ferromagnetic layers that are disposed substantially in a plane,

a third ferromagnetic layer that is not disposed in said plane, said third ferromagnetic layer having a first portion disposed adjacent to said first ferromagnetic layer, a second portion disposed adjacent to said second ferromagnetic layer and a third portion disposed between said first and second portions and distal to said first and second ferromagnetic layers,

a nonferromagnetic, electrically conductive layer adjoining said third ferromagnetic layer distal to said first and second ferromagnetic layers, and

a fourth ferromagnetic layer adjoining said conductive layer,

wherein said fourth ferromagnetic layer has a magnetic moment that is fixed in the presence of an applied magnetic field, said first and second portions of said third ferromagnetic layer have magnetic moments that are fixed in the presence of said applied magnetic field and said third portion of said third ferromagnetic layer has a magnetic moment that varies in response to said applied magnetic field.

18. The sensor of claim 17, further comprising first and second nonferromagnetic, electrically conductive exchange coupling layers adjoining said first and second ferromagnetic layers and said third ferromagnetic layer.

19. The sensor of claim 18, wherein said exchange coupling layers include ruthenium, iridium or rhodium.

20. The sensor of claim 18, further comprising first and second antiferromagnetic layers adjoining said first and second coupling layers distal to said third ferromagnetic layer.